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(71) Applicant
BBC Brown, Boveri & Company Limited, Baden, Switzerland
(72) Inventor
Alain Perregaux
(74) Agent
Carpmaels & Ransford

(54) Polariser Having Adhesion and Protective Layers

(57) A polariser comprises a polarisation foil which is placed between a layer causing adhesion and a layer less than 50 μm thick giving protection from external influences. If the protective layer consists of a lacquer of the type which is used for coating packaging foils in the foodstuffs packaging industry, then the thickness of the polariser provided with protective layers on both sides may be reduced to much less than 50 μm, without the polariser sacrificing its outstanding resistance to chemical and mechanical influences.

Such a polariser is produced by providing the polarisation foil of a transfer polariser, which can be pulled off a support foil, on the side remote from the support foil, with the layer causing adhesion, removing the support foil, providing the polarisation foil with the protective layer on the side previously attached to the support foil, and applying a support foil provided with the adhesive layer to the protective layer.

The polariser may be used in an electro-optically activable cell, magneto-optical display, reflection blocking filter, sun spectacles or cameras.

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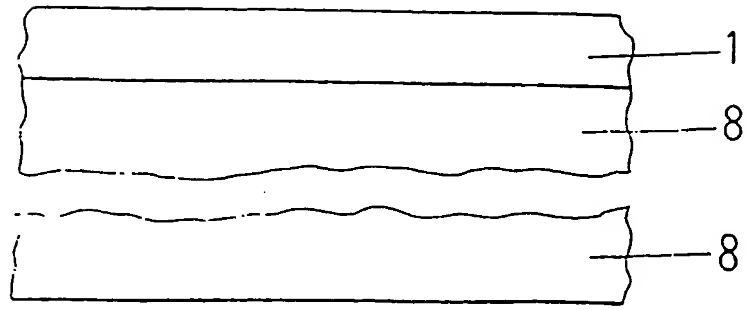

FIG.1

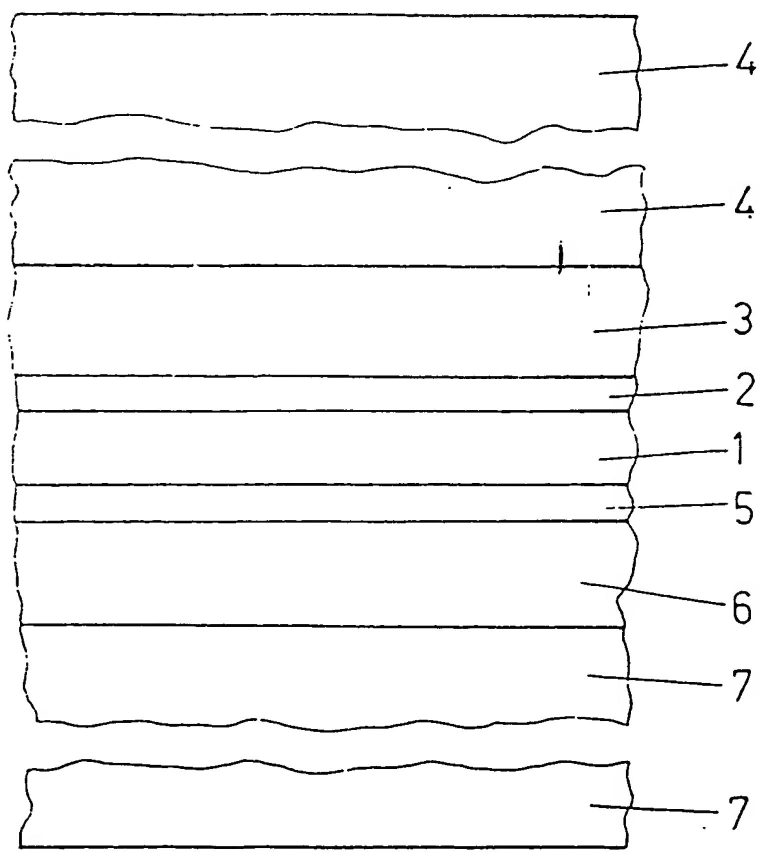

FIG. 2

SPECIFICATION

Polariser for an Electro-Optically Activable Cell and M thod of Producing It

The present invention relates to a polariser for an el ctro-optically activable cell with a polarisation foil which is placed between a layer causing the adhesion to the cell and a layer giving protection against external influences, and to a method of producing such a polariser.

Polarisers of the above-mentioned type are required on each of the two sides of an electro-optically activable cell, such as e.g., a twisted menatic liquid crystal cell utilizing the Schadt-Helfrich effect. Layer-shaped plastics polarisers are used preferably for this purpose. These polarisers are substantially constructed of two parts, namely a polarising or optically active layer, customarily foil-shaped, and either a single support foil present on one side of the polarising layer and performing a protective function, or two support foils provided on the two sides of said layer. The first-mentioned polariser is customarily designated a "simple" or "asymmetrical polariser" and the second-mentioned a "symmetrical" or "sandwich polariser".

In their customary commercial construction as a support foil, simple polarisers exhibit an approximately 130 μm thick cellulose acetobutyrate (CAB) foil, and as polarising layer a stretched polyvinyl alcohol (PVA) foil, such as is produced e.g., by the Polaroid Corporation, Polariser Department, 20 Ames Street, Cambridge, Mass, 021 39, USA and Baum Chemical Corporation) now Foster Grant International, Ziralor Divison) Van Nuys California, USA, or a stretched polyvinylbutyrate (PVB) foil such as is produced e.g., by American Polarizers, 141 South Seventh Street, Reading, Penn. 19603, USA. The thickness of the polarising layer is between 10 and 20 μm, so that the thickness of the polariser is approximately 140 μm.

When such simple polarisers are used in liquid crystal cells, these polarisers are provided on the PVA or PVB side with a layer of a self-adhesive agent, so as to achieve the adhesion to the cell as well as the protection of the polarising layer.

Sandwich polarisers exhibit, in their customary commerical construction, a stretched PVA foil which is provided on both sides with approx. 76 mm thick cellulose triacetate foils. Such polarisers, produced eg., by Sanritsu Electric Co. Ltd., 1-30-13 Narimasu, Itabashi-Ku, Tokyo/Japan are therefore approximately 170 μm thick. They are characterised by high mechanical stability (no distortion) under frequent temperature variations and in the presence of moisture, and also high chemical stability in heat and moisture (little bleaching). There are also sandwich polarisers in which the polarisation foil is arranged between two approx. 50 μm thick acrylplastics foils. Polarisers of this type are characterised by a thickness of only 120 μm, but are extremely sensitive to mechanical influences due to the softness of the acrylplastics foils.

In addition to the simple and the sandwich polarisers, there is a further polariser. This so-called "transfer polariser" which is produced e.g., by the above-mentioned American P larizers, is very similar to the simple polaris r, from which it differs however in that the polarising layer adheres only lightly to the supp rt foil. The polarising layer of this transfer polariser can be applied to a glass surface without adhesive medium, and the support foil can then be removed. The transfer polariser is characterised by its small thickness of only 20 μm, but it is unsuitable for use in liquid crystal cells from considerations of cost due to the complicated process of application to the glass surface, and is furthermore extremely susceptible to mechanical and chemical influences.

It is now the aim of the invention to produce a polariser of the above-mentioned type which exhibits a smaller thickness than the known simple and sandwich polarisers, but is protected from the external mechanical and chemical influences and can be produced cheaply in an economical process and is extremely easy to apply to liquid crystal cells.

The above-stated aim is achieved according to the invention in that the thickness of the protective layer is smaller than 50 μm.

The method according to the invention is characterised by the fact that the polarisation foil of a transfer polariser which can be pulled off a support foil is provided on the side remote from the support foil with the layer causing the adhesion to the cell, the support foil is removed, the polarisation foil is provided with the protective layer on the side previously attached to the support foil, and a support foil provided with an adhesive layer is applied on the protective layer.

The polariser according to the invention is characterised by a small thickness, and also by the fact that its polarising layer is protected from external influences. It therefore exhibits the advantages of the simple and sandwich polarisers and also of the transfer polarisers, but not their disadvantageous characteristics. It can furthermore be produced in an extremely simple and economical manner and is extremely easy to apply to the glass surface of electro-optically activable cells.

Thin polarisers are of more particularly importance for clock or watch displays, because e.g., flat wristlet watches are preferred by the buyer from the aesthetic standpoint and also for greater comfort in wear.

The polariser according to the invention is particularly well protected from external influences if the protective layer consists of moisture-repellent cured lacquer and exhibits a thickness of not more than 15 μm. In this case it has been found particularly successful for the lacquer to be a lacquer of the type which is required for overpainting packaging foils in the foodstuffs packaging industry, and for the protective layer to exhibit a thickness of not more than 5 μm.

Exemplary embodiments of the object of the invention are illustrated in simplified form in the accompanying drawing, wherein:

Fig. 1 shows a section through a known transfer polariser, and

Fig. 2 shows a section through a polariser according to the invention.

The "transfer polariser" illustrated in Fig. 1 exhibits a polarisation foil 1 of 10 μm, but not more than 30 μm thickness and a support foil 8. This polariser is first of all provided on the side of the polarisation foil 1 with an adhesive layer 3, approx. 20 μm, but not more than 30 μm, thick, shown in Fig. 2, of a polyacrylate adhesive. Upon said adhesive layer 3 there is then applied a masking foil shown in Fig. 2, comprising a slightly siliconised polyester, polypropylene or polyvinylchloride or a corresponding material with a thickness of between 20 and 150 μm. It is decisive in this context that the adhesive action of the adhesive layer 3 on the masking foil 4 is weaker than on the polarisation foil 1 or the protective layer 2. The support foil 8, which is unsuitable for use in liquid crystal cells due to its insufficient adhesion to the polarisation foil 1, its thickness and its rigidity, is then removed in a laminating machine and a protective layer 5 of approximately 5 μm, but not more than 15 μm thick, illustrated in Fig. 2, consisting of a moisture-repellent lacquer, is doctored onto the polarisation foil 1 on the side remote from the adhesive layer 3 and cured.A nitro lacquer of the type used for over-painting food packaging foils has been found successful. The application of the protective layer 5 may be performed with advantage, not only by doctoring on, but also by rolling on or spraying on.

Optimum protection of the polarisation foil from external mechanical and chemical influences is obtained if, before the application of the adhesive layer 3, a further protective layer 2 shown in Fig. 2 is applied in corresponding manner.

A further layer, illustrated in Fig. 2, is applied on the protective layer 5 which causes the adhesion of a support foil 7 illustrated in Fig. 2 to the protective layer 5. It is important in this context that the adhesive action of the layer 6 on the protective layer 5 is weaker than on the support layer 7. The thickness of this layer 6 and of the support foil 7 are not critical, values of 30 μm for the layer 6 and of 20 to 150 μm for the support foil 7 may be designated as typical.The support foil 7 may be any commercially available plastics foil, e.g., a PVC foil, which can be coated with a self-adhesive agent. The adhesive layer 6 is conveniently applied first of all to the support foil 7 and not to the protective layer 5. When the support foil 7 is pulled off the polariser which has been pressed onto the glass surface of a liquid crystal cell after removing the masking foil 4 with the adhesive layer 3, the adhesive layer 6 remains adhering to the surface of the support foil 7, and the polariser surface is free of adhesive residues.

The following thickness measurements are obtained for a polariser according to the invention applied to an electro-optically activable cell:

Layer	*Maximum layer thickness (μm)*	*Typical layer thickness (μm)*
Adhesive layer 3	30	20
Protective layer 2	15	5
Polarisation foil 1	30	10
Protective layer 5	15	5
Total	90	40

In the case of known simple or sandwich polariser, after it has been applied with a 20—30 μm thick adhesive layer to the surface of the liquid crystal cell, an overall thickness of 150—170 μm is obtained, so that with the polariser according to the invention up to 130 μm, i.e., up to 260 μm per cell in thickness is typically gained.

The polariser according to the invention may also be used in PLZT (Lead—Zirconate—Titanate doped with Lanthanum) and double refraction—e.g., magneto-optical displays, in reflection-blocking filters (polariser combined with quarter-wavelength filter) for enhancing contrast in light-emitting displays, in sun spectacles and in photographic cameras.

Claims

1. A polariser for an electro-optically activable cell with a polarisation foil which is placed between a layer causing the adhesion to the cell and a layer providing protection against external influences, the thickness of the protective layer being less than 50 μm.

2. A polariser according to claim 1, wherein the protective layer consists of moisture-repellent cured lacquer and exhibits a thickness of not more than 15 μm.

3. A polariser according to claim 2, wherein the lacquer is a lacquer of the type required for over-painting packaging foils in the foodstuffs packaging industry, and the protective layer exhibits a thickness of not more than 5 μm.

4. A polariser according to any of claims 1 to 3, wherein a further protective layer of approximately equal thickness is provided between the polarisation foil and the layer causing the adhesion to the cell.

5. A polariser according to any of claims 1 to 3 wherein in order to facilitate the handling of the polariser on the protective layer a further layer is provided which causes the adhesion of a support foil on the protective layer, whilst the adhesive action of said further adhesive layer is weaker on the protective layer than on the support foil.

6. A method of producing the polariser according to claim 1, wherein the polarisation foil of transfer polariser which can be pulled off a support foil is provided on the side remote from the support foil with the layer causing the adhesion to the cell, the support foil is removed, the polarisation foil is provided with the protective layer on the side previously attached to the

support foil, and a support foil provided with an adhesive layer is applied on the protective layer.

7. A method according to claim 6, wherein the polarisation foil is provided with a protective layer on its side remote from the support foil before the application of the layer causing the adhesion to the cell.

8. A method according to claim 6 or 7, wherein the protective layers are applied by doctoring on, rolling on or spraying on a curable lacquer.

9. A polariser for an electro-optically activable cell substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

10. A method of producing a polariser substantially as hereinbefore described with reference to the accompanying drawings.

11. A polariser whenever produced to the process of any of claims 6 to 8 and 10.

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